



Security Council

Distr.
GENERAL

S/1994/1206
22 October 1994

ORIGINAL: ENGLISH

NOTE BY THE SECRETARY-GENERAL

The Secretary-General has the honour to transmit to the members of the Security Council the attached communication which he has received from the Acting Director General of the International Atomic Energy Agency (IAEA).

Annex

Letter dated 18 October 1994 from the Acting Director General
of the International Atomic Energy Agency (IAEA) addressed to
the Secretary-General

Please find attached the report of the twenty-sixth International Atomic Energy Agency inspection in Iraq under Security Council resolution 687 (1991). You may deem it appropriate to transmit the report to the members of the Security Council. The Director General remains, of course, available with the Chief Inspector, Mr. Garry Dillon, for any consultations you or the Council may wish to have.

(Signed) Boris SEMENOV
Acting Director General

Enclosure

Report on the twenty-sixth IAEA on-site inspection in Iraq
under Security Council resolution 687 (1991)

22 August to 7 September 1994

SALIENT POINTS

The following activities were carried out in the course of the twenty-sixth IAEA inspection in Iraq: (i) an investigation of Iraq's former activities in the field of laser isotope separation; (ii) the implementation of activities in connection with the ongoing monitoring and verification (OMV) plan, with particular respect to the utilisation of machine tools, non-nuclear materials and other equipment; (iii) inspections at sites associated with the former nuclear weapons programme. A total of 16 facilities, installations and sites were visited in the course of this inspection.

- An investigation was carried out, principally at the Tuwaitha site, into Iraq's former activities in the area of laser isotope separation (LIS) covering the procurement and development of laser equipment and research in both molecular (MLIS) and atomic vapour (AVLIS) laser isotope separation technologies. The investigation resulted in an admission by Iraq, that contrary to previous statements, they had, during the period 1981 to 1987, assigned resources to the task of exploring the feasibility of LIS, as a means of producing enriched uranium. In connection with this investigation, visits were made to Tarmiya, the Laser Department of the Baghdad Technical University and the College of Science at the University of Baghdad.
- Inspections were carried out at six sites where items of equipment subject to routine monitoring in accordance with Annex 3 of the OMV plan were located.

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- Inspections were also carried out at four sites with previous nuclear or nuclear related missions or which had provided support to the former nuclear programme, at one site which has been judged to have capabilities which could contribute to a reconstituted nuclear programme and at two sites with a means of electrical supply greater than 10 MVA.
- Concurrently with this inspection the IAEA established its continuous presence in Iraq in connection with the implementation of the OMV.

INTRODUCTION

1. This report summarises the results of the twenty-sixth on-site inspection carried out in Iraq by the IAEA under the United Nation Security Council resolution 687 (1991), with the assistance and co-operation of the Special Commission of the United Nations. The inspection took place from 22 August to 2 September 1994 and was lead by Garry Dillon of the IAEA as Chief Inspector. Three members of the team remained in Iraq until 7 September to carry out activities in connection with the OMV and to follow-up on matters arising from the inspection. The team consisted of 18 inspectors, comprising 11 nationalities.
2. The primary objectives of the inspection were:
 - to carry out an investigation into Iraq's former activities in the area of laser isotope separation (LIS) covering the procurement and development of laser equipment and research in both molecular (MLIS) and atomic vapour (AVLIS) laser isotope separation technologies.
 - to carry out inspections at sites where items of equipment subject to routine monitoring in accordance with Annex 3 of the OMV plan were located.

- to carry out inspections at sites with a previous nuclear or nuclear related missions or which had provided support to the former nuclear programme or which have been judged to have capabilities which could contribute to a reconstituted nuclear programme.
- to carry out inspections at sites with a means of electrical supply greater than 10 MVA.

INVESTIGATION INTO IRAQ'S FORMER LIS ACTIVITIES

3. In May 1994 the IAEA received information from Member States which indicated that Iraq had invested significant resources in research into uranium enrichment through laser isotope separation (LIS) involving both molecular (MLIS) and atomic vapour (AVLIS) technologies.
4. This subject of LIS was first addressed by IAEA-7 (October 1991), at which time that team had received two written statements from a senior Iraqi official denying that Iraq had undertaken any laser enrichment activities and stating that consequently there were no Iraqi personnel who had been involved in such activities.
5. Although it was difficult to accept that, having explored such a wide range of potential enrichment technologies, Iraq would have completely ignored LIS, there was no indications available at that time to support further investigation.
6. The information received in May prompted a thorough re-assessment of the situation. A detailed search for laser related topics in the current Action Team information databases identified a number of activities with respect to laser component manufacture, particularly CO₂ lasers and the manufacture of components for use in laser related experimentation. The database search also identified an abstract from

- an Iraqi unclassified report entitled "Dissociation of UF_6 molecules by UV laser". This information taken together with procurement data and the information provided by the Member States formed the knowledge base for the investigation.
7. The investigation carried out by the IAEA-26 inspection team, which included five experts in laser technology, extended over five inspection days and for the first two days members of the team remained on the Tuwaitha site "round the clock" to maintain a continuous inspection regime until all relevant locations had been inspected.
 8. The most significant event occurred during a seminar, presented by the Iraqi counterparts on the fifth inspection day, where a statement was made to the effect that the Laser Section 6240 had "received an objective [in 1981] from the Atomic Energy Commission to work in Laser Isotope Separation We started in two lines; one which is looking after the molecular and the other the atomic direction".
 9. The IAEA team was also advised that when the achievements of Section 6240 were evaluated in 1987 it was decided that the project should be downgraded to a "watching brief" and that a number of key personnel should be transferred to the other programmes, notably EMIS.
 10. The seminar provided a more coherent and, in some respects, more detailed explanation of the information given to the team in the course of the investigation; the major difference being that its connection with LIS was now acknowledged.
 11. One IAEC staff member, who was brought to the Tuwaitha site specifically to take part in the seminar, described the work he had done on the photoionisation of sodium and rubidium. This individual appeared to be highly motivated and technically competent and described an experimental set-up that had a number of features similar to those of the equipment described in the information provided to

the IAEA by Member States. The subsequent transfer of this individual to the EMIS programme is consistent with the declared decision to downgrade the LIS related activities of Section 6240.

12. The IAEA team noted that, as now acknowledged by Iraq and contrary to their written statements in October 1991 and to the FFC ¹ (June 1992), a specific task to explore the feasibility of LIS as a means of producing enriched uranium had existed. The task appears to have been poorly focused and its limited achievements appear to be consistent with the equipment, personnel resources and expertise available.
13. The team was satisfied that the information it had gathered during the investigation, regarding the resources, capabilities and activities of Section 6240, was consistent with a loosely co-ordinated and largely empirical approach to LIS, but not consistent with the achievement of substantial progress in what is a complex technology.
14. There were no indications that the efforts of Section 6240 reached the point of an integrated experiment that achieved any isotopic separation of either elemental uranium or UF₆ or that they had developed, even the most rudimentary capabilities in either AVLIS or MLIS technologies.
15. It was also apparent from statements made in the course of the inspection by the Iraqi scientists and senior officials, that export controls and voluntary refusals on the part of several equipment suppliers had severely hampered the Iraqi LIS activities by preventing the procurement, from abroad, of critical pieces of equipment, most notably copper vapour laser systems.
16. A summary of the discussions and inspection activities carried out during this investigation is included in the Annex to this report.

¹ The Full, Final and Complete Report of Iraq's nuclear programme required under Security Council resolution 707 (1991).

INSPECTIONS AT FACILITIES, INSTALLATIONS AND SITES

17. Inspections were carried out at seven locations, Babyl Company, Badr, Daura, Nassr, Al Nidda, Al Radwan and Saddam General Establishment, in order to survey the general activities of the facilities and to monitor the status and utilization of machine tools subject to routine monitoring in accordance with the OMV plan.
18. Many of the establishments are contributing to the Nassr Rolling Mill project but even so the majority of them appeared to be operating well below their production capacity. The team members experienced no difficulties in gaining access to production records and workpiece drawings and there were no indications that any machine tools were being used for proscribed purposes.
19. In addition to the inspections carried out at Tuwaitha and Tarmiya, referred to above, inspections were carried out at the Al Qaim phosphate fertilizer plant, at the former centrifuge production facility at Al Furat and at the Al Amil liquid nitrogen production facility. The activities carried out at Al Qaim were in connection with the work on uranium accountancy and are summarized below. The inspection at Al Furat showed that building B01 and B02 remained unchanged whilst in the rest of the facility the work on the buildings conversion was nearing completion. There was very little activity at the site and no indication that the buildings were soon to be outfitted and occupied. The activities at Al Amil were found to be consistent with the function of the facility.
20. Al Kindi, a location considered as having capabilities that could be useful to a reconstituted nuclear weapons programme, was inspected in company with the UNSCOM ballistic weapons group. Equipment subject to routine monitoring in accordance with annex 3 of the OMV plan was satisfactorily accounted for and there

were no indications that any items of equipment were being used for proscribed purposes.

21. An inspection was also carried out at Al Karkh which is a site with a means of supply of electricity greater than 10 MWe. A detailed check of the electrical power supply system was made and it was found to be consistent with the information provided by Iraq in accordance with the OMV plan.
22. The opportunity was taken to meet with the Director of the Iraqi National Monitoring Directorate (NMD) on the status of the preparations for the implementation of the OMV plan and the procedures that would be followed by the IAEA in carrying out its monitoring inspections, the majority of which would be unannounced. The format and content of the next issue of Iraq's OMV relevant reports was discussed and agreed in principle and the NMD Director also stated that responsible personnel had been designated at each location to facilitate the work of the IAEA and UNSCOM monitoring groups. He also advised that this relatively large group of personnel had participated in a training seminar at the NMD.
23. At the conclusion of these discussion the Chief Inspector stated that concurrently with IAEA-26 the IAEA had established its continuous presence in Iraq and was technically ready to implement the OMV plan.

URANIUM ACCOUNTANCY

24. An inspection was carried out at the Al Qaim facility and samples of phosphate rock and uranium bearing sludge were obtained. Discussions were held with facility personnel regarding some aspects of the operation of the former uranium extraction plant. These discussions and in particular the data contained in a process log book, showing all analytical data for all of the declared yellowcake production, made available to the group, clarified some technical details regarding plant operation.

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25. The Iraqi counterparts were requested to arrange to pump out the water from one of the two pits of the building 73 complex liquid waste tanks. Their endeavours to do this during IAEA-26 were unsuccessful due to the burn-out of the submersible pump and the task will be completed during IAEA-27. A sample of the sludge contained in one of the liquid waste tanks was taken and was found to be similar to other waste material in store at Location C.
26. An inventory check was made of the uranium material in store at Location C and all batches identified as line entries in the IAEA-12 listing were tagged. A small number of samples were taken, primarily from previously unsampled items.

Table 1

List of facilities, installations and sites
inspected in IAEA-26

1. Al Amil
2. Al Furat
3. Al Kharkh
4. Al Kindi
5. Al Nidda
6. Al Qaim
7. Al Radwan
8. Babyl Company
9. Badr
10. College of Science, University of Baghdad
11. Daura
12. Nassr
13. Saddam State Establishment
14. Tarmiya
15. Baghdad Technical University
16. Tuwaittha

Annex

SUMMARY OF DISCUSSIONS AND INSPECTION ACTIVITIES CARRIED OUT DURING THE INVESTIGATION OF IRAQ'S FORMER ACTIVITIES IN THE AREA OF LASER ISOTOPE SEPARATION

1. On the first inspection day, the team, which included five experts in laser technology, met in Tuwaitha with the Iraqi counterparts and the Chief Inspector explained that the purpose of the inspection was to re-examine the activities carried out in Iraq on laser research and development with particular respect to activities carried out involving lasers and uranium. The Iraqi counterparts were advised that the IAEA team required to interview the principal personnel involved with the Laser Section since the early 1980s and to revisit the various buildings known to be associated with laser activities in order to evaluate past and current projects and to reassess the laser equipment. The Iraqi counterparts were also advised that team members would remain in Tuwaitha "round the clock" to maintain the continuous inspection regime until all relevant locations on the site had been examined.
2. The first session of the inspection was used to review the laser activities in Tuwaitha with the head of the Department of Physics (6200) and the head of the Laser Section (6240). The Iraqi side made the opening statement that they had never regarded LIS as a practical option for uranium enrichment and stressed that all of their work in this area had been on what they considered to be proven enrichment technologies such as gaseous diffusion, EMIS and centrifuge.
3. It was explained to the team that, in 1977, the Laser Section was established in building 10 (Physics), which is contiguous with building 9 (Radio-chemistry) and in 1986 expanded into building 23 (Laboratory Workshop Building - LWB). The Laser Section was stated to have only the general objective to acquire technology. The Laser Section is currently housed in building 90, outside the berm (see figure 1).

4. The discussions were then interrupted and the IAEA team carried out an inspection at buildings 9 and 10, including the basement areas of both buildings and were shown the location on the ground floor of building 10 which was occupied by the laser section from 1977 to 1991. Smear samples were taken from this area during IAEA-26.
5. Discussions were then resumed and the Chief Inspector tabled the abstract from the paper on UF_6 dissociation; two of the discussion participants were included in the list of five co-authors of this paper. Neither of these individuals were apparently able to recall the paper. The Chief Inspector stated that it was very hard to accept that this experiment, which was significant if only because of the involvement of lasers and uranium could not be recalled and determined that discussions be suspended to enable the Iraqi counterparts to review the situation.
6. Concurrent with these two discussion sessions, a sub-group of IAEA team members, with civil, mechanical and electrical engineering expertise, had carried out a thorough inspection of the basement of building 23 (LWB). The building had sustained severe bomb damage during the Gulf war and the above ground structure had been completely demolished by the Iraqis and removed from the site in 1992. The basement area had been renovated to provide a storage facility.
7. In order to maintain a continuous inspection regime this group of personnel remained on the Tuwaitha campus overnight and made frequent, randomly timed tours of the site until the arrival of the rest of the team on the morning of the second inspection day.
8. During the morning of the second day of inspection the team carried out inspections at buildings 23, 12, 90 and 82 in order to give the members of the team with laser expertise the opportunity to examine the facilities and equipment. No new information of significance was obtained from these inspections.

9. The building inspections were followed by a discussion session. The session commenced with a restatement by the Iraqi side that "LIS had never been looked at seriously in the work done by Iraq on the front end of the fuel cycle".
10. It was also stated that laser research was nevertheless considered to be an appropriate activity to be included in the IAEA programme rather than for it to be assigned solely to the universities but that the Laser Section had, at all times, remained part of Department 6000 (IAEA) whereas all activities related to the former nuclear weapons programme were in Department 3000.
11. The Iraqi side also stated that there had been "no *indulgence* of lasers in LIS" and although some limited experimentation had been done with UF_6 there had been no isotopic separation - no isotopic enrichment. One of the five co-authors of the UF_6 dissociation paper was then able to give an overview of his work in the laser section and to describe the experiment he had carried out with UF_6 .
12. He explained that the experiment described in the abstract had only been carried out once and had involved the excitation of less than one gram of UF_6 contained, at 1-3 mbar, in a sealed monel metal cell which was equipped with quartz windows and which had not been passivated. The experiment had used a XeCl Excimer laser with a pulse energy of 2-4 mJ and a pulse duration of 10 ns. The decrease in cell internal pressure was monitored throughout the experiment and the presence of UF_5 / UF_4 was stated to have been determined using X-ray diffraction techniques.
13. The team members discussed the experimental process with the author and it became evident that the work was of a rudimentary nature and would represent only a tentative step towards MLIS technology. He was most insistent that only one such experiment had been carried out and stressed that it was only with difficulty that he had been able to obtain the small amount of UF_6 that had been used.

14. He stated that the lack of appropriate lasers to permit selective dissociation to be achieved was the reason why no further work had been done in this area.
15. The Chief Inspector asked about the location of the original report, the abstract of which had been photographed during IAEA-6 and stated that it would be a valuable demonstration of openness and a meaningful technical contribution to the investigation if the Action Team could now be provided with a complete copy of the report. The Iraqi counterparts described at length the situation just prior to IAEA-6 and the instructions that had been given to surrender for destruction all technical documents associated with the former nuclear weapons programme.
16. The team acknowledged this history but countered that it would have been illogical to destroy documents after IAEA-6 since the majority of these documents had been eventually surrendered to that team. The Iraqi counterparts were therefore further encouraged to try to locate a copy of the report.
17. The Iraqi counterparts were then asked for a description of corresponding experimental work that had been done in the field of AVLIS or of any work that might have been construed to have been associated with AVLIS for example experimental high vacuum assemblies, lasers and uranium metal. There being no meaningful response to this question discussions were adjourned.
18. At this stage in the investigation all relevant locations on the Tuwaitha campus had been inspected and the decision was taken to terminate the continuous presence of team members on the site.
19. The third day of inspection started with a detailed re-examination of the coating device, located in building 12, which had some of the physical attributes of the equipment described in the information received by the IAEA on AVLIS activities thought to have been carried out in Tuwaitha.

20. The head of the group responsible for the operation of the coating device explained that he had re-commissioned the device in 1985 in building 23 and that it was then in virtually new condition, having only been previously used a few times. He then voluntarily opened up the device to enable the team members to examine the electron gun and the crucible assembly.
21. The current configuration of the vacuum chamber was such that a collimated vapour beam from the crucible would not have intersected with the flanges in the body of the vessel if these flanges had been used to accommodate windows for laser light transmission. The Iraqi scientist in charge of the coating group was adamant that the configuration of the device had not been changed since 1985, when the coating device had been commissioned in building 23, apart from the replacement of the turbo pump in 1991.
22. Smears were taken from the internals of the vacuum chamber, the electron gun and the crucible. These surfaces were also directly monitored and found to be free from alpha contamination.
23. The team resumed discussions with the Iraqi counterparts who made an opening statement confirming that Iraqi scientists had carried out a few experiments on non-selective photo-dissociation including the single experiment with UF_6 that had been described the previous day but that no spectroscopy work had been done on UF_6 or on uranium metal vapour. The Chief Inspector responded that the team needed to be informed of any experimental activity that was related to, or could appear to be related to, LIS and, in particular, AVLIS.
24. Discussions then continued on the work done by the Laser Section to develop a 10 watt copper vapour laser. The scientist in charge of this activity explained that the project was the result of his own interest, inspired by published scientific information and that he had no identified use for the laser except for spectroscopy.

25. He went on to explain that the project had been of only minor success, that the laser had never operated stably and that the best runs were typically of 10-20 minutes duration at a sustained power level of about 3 watts.
26. At the teams request this same scientist described the work he had carried out on the development of a molecular beam based on an automobile fuel injector. This project was described to have been a failure and was therefore never used in conjunction with lasers.
27. At this stage the Chief Inspector gave an overview of the information made available to the IAEA which described the AVLIS activities presumed to have been carried out in Iraq and principally at Tuwaitha. He advised the Iraqi counterparts of his own firm opinion that it was most unlikely that Iraq had solved the technical problems of AVLIS technology and therefore even more unlikely that they enriched meaningful amounts of uranium through this process.
28. He however stated himself to be firmly convinced that Iraq had done more work towards LIS than they had shared with the Action Team during the inspection and was equally firmly convinced that the reluctance of the Iraqi counterparts to admit to the actual scope of their work in this area would have damaging consequences far beyond the technical significance of the work itself.
29. The Iraqi counterparts responded that there had never been any work of the nature described in the information provided to the IAEA and that there had never been any foreign involvement in their laser activities. They however suggested that they would make arrangements to present a seminar, two days hence, on the planned final day of this phase of IAEA-26.
30. The next inspection day was used to carry out a visit to Tarmiya where buildings 33, 225, 245, 248, 271, and 381 were inspected (see figure 2). Nothing was observed

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to suggest that LIS related activities, in particular pilot scale production, had been carried out at Tarmiya.

31. On the morning of the day of the seminar visits were made to the Laser Department of the Technical University and to the College of Science at the University of Baghdad.
32. The Technical University was in summer recess and the lack of activity added to the impression that the research and development programme of the Laser Department is somewhat modest. The laboratory rooms appeared to be poorly maintained and the inventory of laser and laser related equipment was unimpressive.
33. One of the reasons for the visit to the Technical University was to clarify supplier information relating to the attempted procurement, in 1989, of a 40 watt copper vapour laser.
34. The team was informed by the Dean of the University and the head of the Laser Department that the attempt to purchase this item was at the request of a, since retired, professor who had wished to use the device for an undefined project aimed at exploring techniques for the determination of air pollution by measurement of backscattered laser light.
35. When it was suggested that this was a relatively expensive item to purchase for an apparently undefined project the team was told that, in the late 1980's the annual operating budget of the Laser Department had been "five to ten" million dollars. This figure was considered, by the team, to be strongly at variance with the observed investment.
36. Summary information has since been provided by the Iraqi counterparts showing that the implemented financial plan for the two year period 1988-01-01 through 1989-12-

- 31 was the equivalent of US\$11.6 million of which only US\$0.27 million was spent on instruments and equipment whilst the major portion of the expenditure was on building costs and furnishings. The information is supported by a copy letter, dated 1990-03-26, which corroborates the summary data.
37. Nothing was seen in the Laser Department that appeared to have the potential to contribute to IAEC's investigations into LIS.
38. In contrast to the Technical University the College of Science appeared to be in session and there were many students on the campus. The coating laboratories which were inspected were well equipped and well maintained.
39. The supervisory staff were very enthusiastic about their programmes and appeared to be technically well informed. The coating systems were standard commercial systems and the associated vacuum enclosures would not have lent themselves for use in activities related to LIS.
40. An additional item of supplier information relating to the attempt to procure a twin gun electron beam melting furnace (150kW, 35kV) was discussed with the senior staff of the College but they had no knowledge of who might have been the initiator of the procurement request.
41. The Iraqi counterparts later clarified that this item was the subject of a procurement request from the Ministry of Industry for use in the melting and casting of titanium alloys.
42. The team was advised that there was no laser equipment on the campus of the University of Baghdad and laser science was included in a general science course as a theoretical topic only. Considering that there are six colleges on the campus this may have been an oversimplified answer.

43. The final session of this phase of IAEA-26 was the seminar presented by the Iraqi counterparts describing their work with lasers. The seminar provided a more coherent and, in some respects, more detailed explanation of the information given to the team in the course of the investigation and is adequately documented in the notes of the IAEA team.
44. The most significant information provided in the seminar was in the opening statement by the head of the Department of Physics (6200) who said that "I received an objective [in 1981] from the Atomic Energy Commission to work in Laser Isotope Separation... We [Laser Section 6240] started in two lines; one which is looking after the molecular and the other the atomic direction". The team were also advised that when achievements of 6240 were evaluated in 1987 it was decided that the project should be downgraded to a "watching brief" and that a number of key personnel should be transferred to other programmes, notably EMIS.
45. One IAEC staff member, who was brought to the Tuwaitha site specifically to take part in the seminar, described the work he had done on the photoionisation of sodium and rubidium. This individual appeared to be highly motivated and technically competent and described an experimental set-up that had a number of features similar to those of the equipment described in the information provided to the IAEA by Member States. The subsequent transfer of this individual to the EMIS programme is consistent with the declared decision to downgrade the LIS related activities of section 6240.
46. It was surprising that, according to the Iraqi statement, the relatively simple step of developing the technology for the production of uranium metal vapour had not been accomplished. The reason, offered during the seminar, that metallic uranium was not available in 1986 is not consistent with other information which shows that uranium metal was actually available at the end of 1986. In a later written response

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to questions on this topic the statement was made that "The UV/Visible Laser section was reorganized in 1986, and even with the availability of U-metal the Laser division still did not have the means for high temperature evaporation (over 2000 C) nor had they the suitable laser power density for uranium vapour interaction with laser".

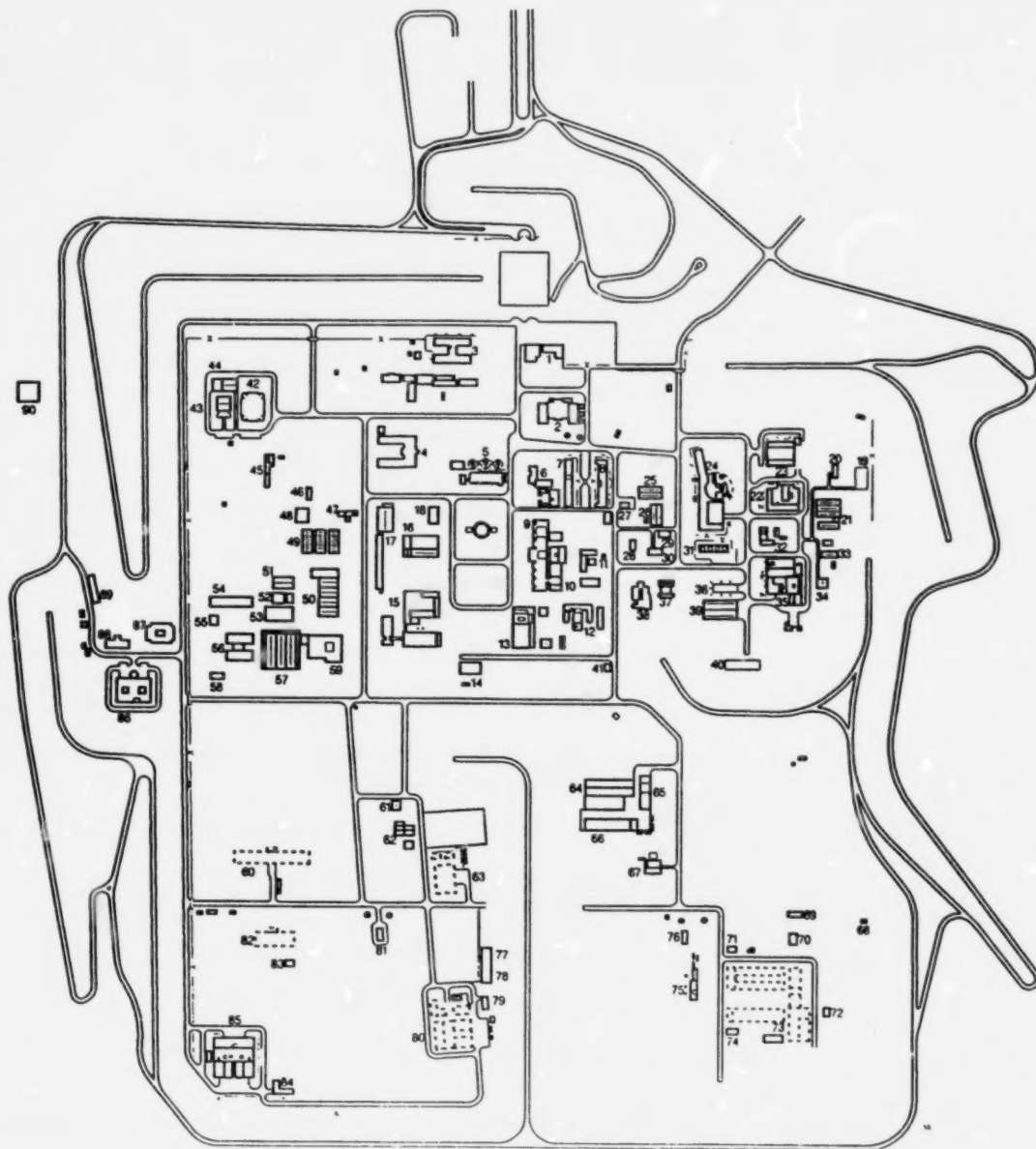
47. The IAEA team noted that, as now acknowledged by Iraq and contrary to their written statements in October 1991 and to the FFC (June 1992), a specific task to explore the feasibility of LIS as a means of producing enriched uranium had existed. The task appears to have been poorly focused and its limited achievements appear to be consistent with the equipment, personnel resources and expertise available.
48. The team was satisfied that the information it had gathered during the investigation, regarding the resources, capabilities and activities of Section 6240, was consistent with a loosely co-ordinated and largely empirical approach to LIS, but not consistent with the achievement of substantial progress in what is a complex technology. There were no indications that the efforts of Section 6240 reached the point of an integrated experiment that achieved any isotopic separation of either elemental uranium or UF_6 or that they had developed, even the most rudimentary capabilities in either AVLIS or MLIS technologies.
49. It was also apparent from statements made in the course of the inspection, by the Iraqi scientists and senior officials, that export controls and voluntary refusals on the part of several equipment suppliers had severely hampered the Iraqi LIS activities by preventing the procurement, from abroad, of critical pieces of equipment, most notably copper vapour laser systems.

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APPROXIMATE SCALE METERS

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